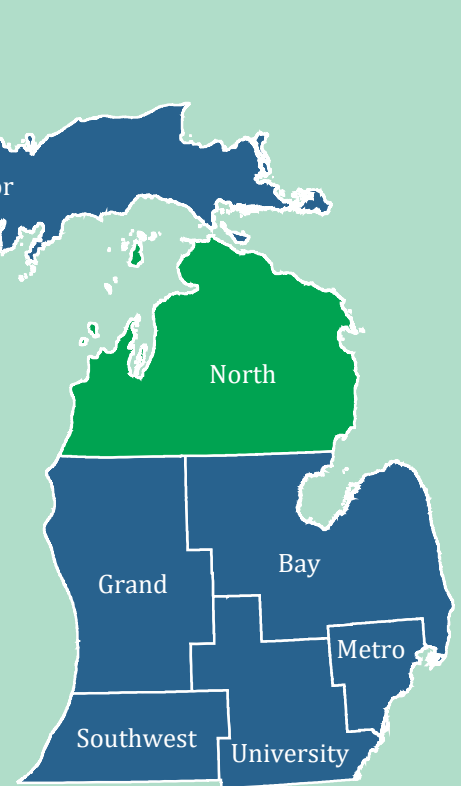


# 2018 Freeway Congestion & Reliability Report



## Chapter 5 NORTH REGION SUMMARY



## PROLOGUE

Since 2014, the Michigan Department of Transportation (MDOT) has used probe vehicle data to create an annual Freeway Congestion and Reliability Report. The probe vehicle data is collected anonymously from GPS enabled devices and in-vehicle telematics to provide real time speeds on roadways nationwide. Probe vehicles provide an enormous amount of data which can be difficult to manage, maintain, and analyze. The University of Maryland Center for Advanced Transportation Technology (CATT) Lab developed a visual analytics platform called the Regional Integrated Transportation Information System, or RITIS. This tool allows MDOT to monitor speeds, incidents, weather, special events, and many other data sources. Using the RITIS platform, data was downloaded, processed, and compiled into a report summarizing all freeway routes in Michigan.

This report is composed of eight chapters. The first chapter summarizes performance measures and statewide metrics. The remaining seven chapters use those performance metrics to characterize congestion in each of MDOT's seven regions. This document is for internal use to help MDOT regions, Transportation Service Centers (TSC), and planners understand how Michigan freeways are operating over time, as well as where potential improvement projects may be necessary. This report is typically used as a starting point for more detailed analysis incorporating additional probe data, as well as other MDOT resources. If your area has plans to share this information externally, please contact the Congestion and Reliability Unit to ensure the correct measures are being used.

The report was prepared by the Wayne State University Transportation Research Group under the guidance of the Congestion and Reliability Unit at MDOT. Please contact the Congestion and Reliability Unit if you have any questions/comments or would like to have the actual data for further analysis.

## ACKNOWLEDGEMENTS



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## INTRODUCTION

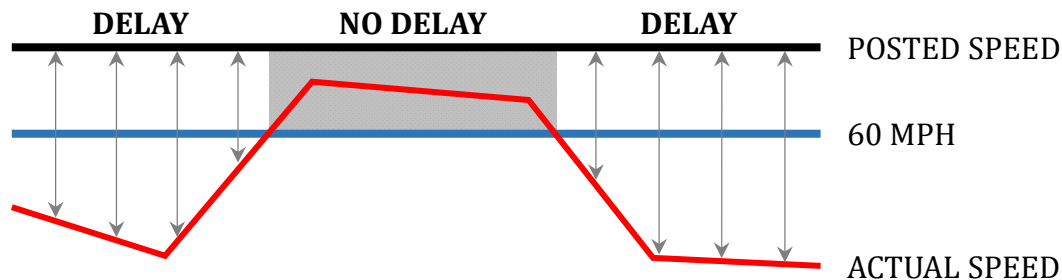
The purpose of this document is to provide a performance overview of Michigan freeways. Using probe vehicle data and systematic performance measures, a series of visualizations were created for each region in the state. Chapter 5 of this report provides an overview of the North Region. North Region is made up of 21 counties and contains the city of Traverse City. Three freeways are analyzed in the section below.



## PERFORMANCE MEASURES DEFINITIONS

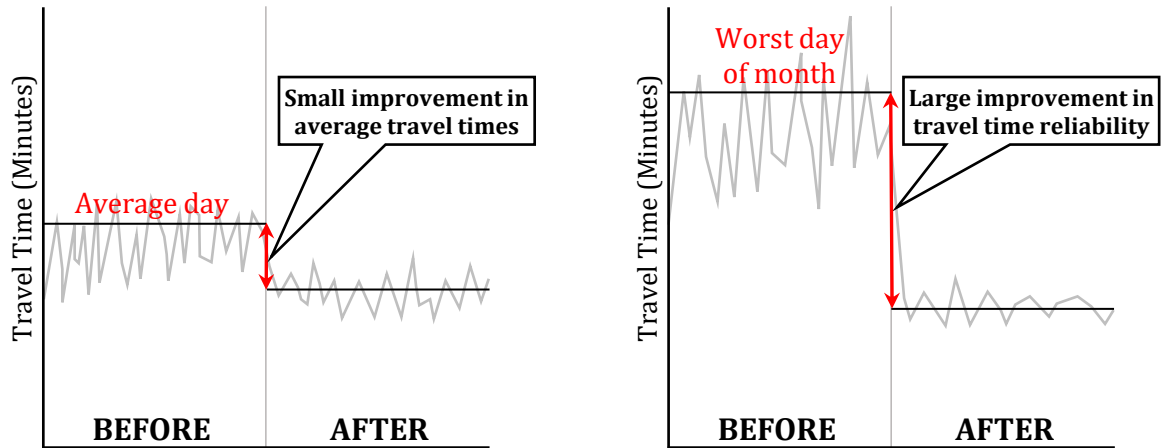
The probe data alone provides representative speeds on predefined segments of roadway every minute. Although this data is rich, it provides limited use to engineers and practitioners without well-defined aggregation techniques. Performance measures are growing in the transportation arena to better monitor traffic conditions, improve traveler information, and identify congested areas with the aim of improving operations on roadways. A summary of the performance measures used in this report can be seen in Table 1.

The goal of these performance measures is to quantify the congestion, delay, and reliability of the freeway network in Michigan. Numerous metrics were used in this report to quantify the performance of the road network, including a new delay index. Delay is quantified when the speed drops below 60 MPH, which is at least 10 MPH lower than the posted speed limit for the freeways (Figure 1). On segments with a speed limit of 55 MPH, delay is calculated when speed falls below that threshold. The delay index presented in this report represents the total delay on each segment if one vehicle were to drive that segment every ten minutes. The lower the value, the better the freeway segment is operating. The other element of interest is reliability. Reliability is a measure of the consistency of a travel time on a roadway. A roadway that has the same travel time every day is said to be reliable, whereas a roadway that has varying travel times is said to be unreliable. MDOT's goal is to provide reliable travel times with minimal delay. This is done through roadway improvement projects which can include additional lanes, pavement improvements, and intelligent transportation systems. These projects can reduce the travel time and also improve the travel time reliability. An example of this is shown in Figure 2.



**FIGURE 1. Delay Calculation**





**FIGURE 2.** Travel Time Average and Reliability Improvements

**TABLE 1. Performance Measures of Interest**

PERFORMANCE MEASURE	Description
<b>DELAY</b>	Delay is calculated by taking the difference between actual speeds when they fall below 60 MPH and the posted speed limit. This is to take out the delay caused by the lower average speeds from commercial vehicles.
<b>DELAY INDEX</b>	Delay index is calculated by adding the delay if a probe vehicle drove every segment of roadway once every ten minutes. This value is then divided by the length of the roadway segment. This allows users to make comparisons between varying corridors and locate areas that cause the most delay.
<b>MAXIMUM DELAY</b>	Maximum delay is the maximum calculated delay per segment throughout a year.
<b>AVERAGE SPEED</b>	Average speed is determined by calculating the space mean speed of the worst ranked hour in the weekday AM peak (6:00 AM - 9:00 AM) and weekday PM peak (3:00 PM - 7:00 PM) periods for each segment of roadway. This is compared to the space mean speed of the previous five year period for the same hour.
<b>CONGESTION SEVERITY</b>	Congestion severity is calculated based on the worst hourly average speed experienced during the AM or PM peak period per traffic message channel (TMC) segment. A TMC segment is a standard for delivering real-time traffic information. They vary from tenths of a mile long to several miles long.
<b>TRAVEL TIME RELIABILITY</b>	Travel time reliability is a measure of travel time consistency over a period of time. When travel times are unreliable, customers are more likely to experience unexpected delays. Travel times are shown to be reliable when the 95 <sup>th</sup> percentile travel time remains close to the average travel time.
<b>AVERAGE TRAVEL TIME</b>	The amount of time a customer should budget to be on-time on average.
<b>95TH PERCENTILE TRAVEL TIME</b>	The amount of time a customer should budget to be on-time 19 out of 20 days (95% of the time). The 95 <sup>th</sup> percentile travel time is also known as the planning time.
<b>LEVEL OF TRAVEL TIME RELIABILITY</b>	Level of travel time reliability (LOTTR) is calculated as the ratio of the 80 <sup>th</sup> percentile travel time to a “normal” travel time (50 <sup>th</sup> percentile). LOTTR measures the consistency and dependability of road segments. The Federal Highway Administration (FHWA) deemed a road segment to be unreliable if its LOTTR value exceeds 1.50.

*Note: May 1<sup>st</sup> through September 30<sup>th</sup> were used for the summer reliability calculations.*





## PERFORMANCE MEASURES VISUALIZATIONS

Performance measures visualizations provide an easy way to graphically represent the performance metrics listed above. In this report, three main visualizations are used. These three visualizations are explained in detail below.

### DELAY INDEX

Figure 3 is an example of the delay index graph. This figure represents I-75 through Gaylord TSC in the North Region. The delay index visualization displays which months are incurring the most delay, while comparing how delay patterns change from year-to-year. Figure 3 shows the following:

- a) Yearly delay index per mile totals (in minutes).
- b) Delay index per mile (in minutes).
- c) Month of year.
- d) Higher than normal delay index per mile values in 2017 and 2018.
- e) A delay index per mile value of over 60 minutes in December 2016.

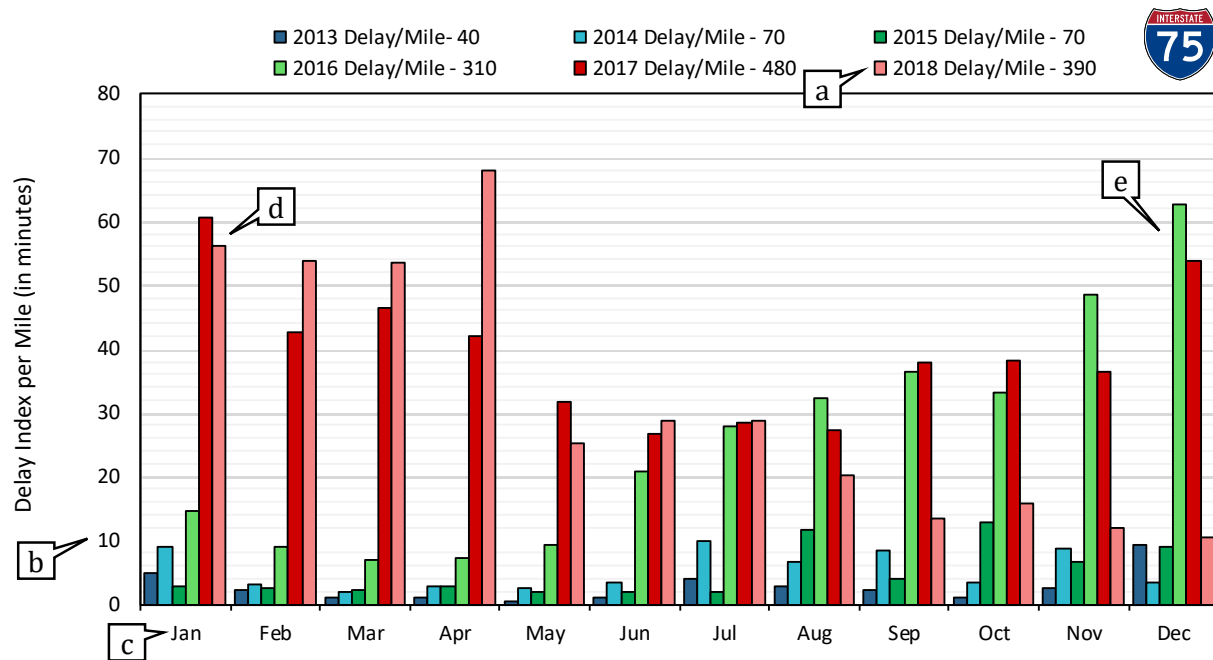


FIGURE 3. Example Delay Index Graph





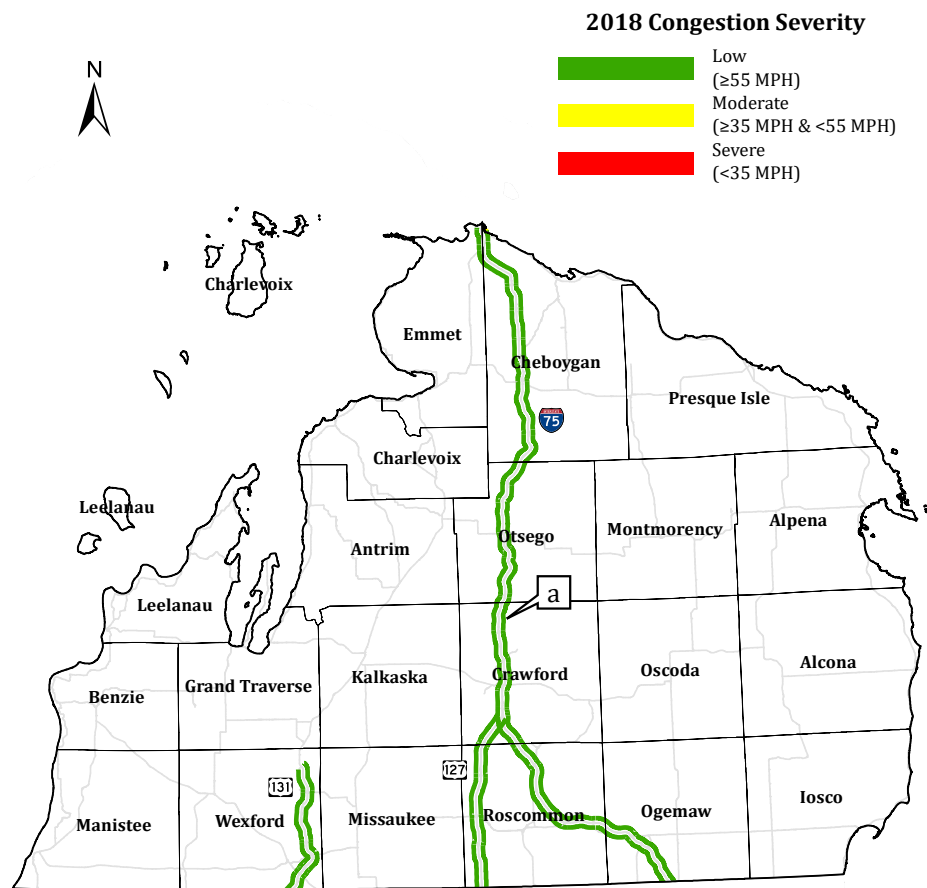
## CONGESTION SEVERITY

Figure 4 shows an example of the congestion severity map. This figure represents North Region during the PM peak hour. This performance metric displays the amount of congestion on corridors during AM and PM peak periods by representing speeds in a color gradient. The color gradient consists of three different categories to distinguish severity levels:

- a) Low ( $\geq 55$  MPH).
- b) Moderate ( $\geq 35$  MPH &  $< 55$  MPH).
- c) Severe ( $< 35$  MPH).

Figure 4 shows the following:

- a) All roads are operating efficiently because there is low congestion.



**FIGURE 4.** Example Congestion Severity Map



## LEVEL OF TRAVEL TIME RELIABILITY

Figure 5 shows an example of the level of travel time reliability map. This figure represents North Region during weekdays between 6:00 AM – 10:00 AM. This performance metric displays the consistency and dependability of road segments by analyzing vehicular travel times from day-to-day or across different times of the day. LOTTR is defined as the ratio between the 80<sup>th</sup>-percentile travel time to the 50<sup>th</sup>-percentile travel time. In order to determine if a road segment has reliable travel times, LOTTR utilizes a threshold value of 1.50. Therefore, a segment providing a calculated LOTTR value less than 1.50 would claim to have reliable travel times. As delegated by FHWA, the following time periods were used in the making of these graphs:

- Weekdays between 6:00 AM – 10:00 AM.
- Weekdays between 10:00 AM – 4:00 PM.
- Weekdays between 4:00 PM – 8:00 PM.
- Weekends between 6:00 AM – 8:00 PM.

LOTTR is represented in a color gradient that consists of three different categories to distinguish severity levels:

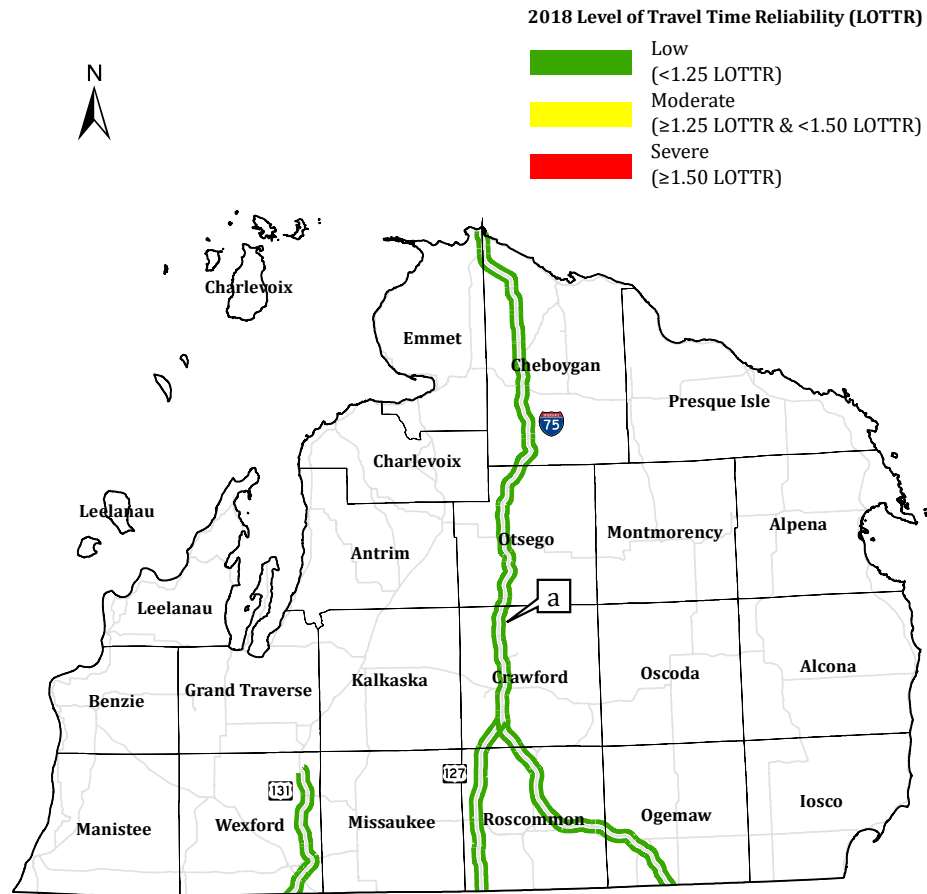
- Low ( $<1.25$  LOTTR).
- Moderate ( $\geq 1.25$  LOTTR &  $<1.50$  LOTTR).
- Severe ( $\geq 1.50$  LOTTR).

Figure 5 shows the following:

- a) Most roads have very reliable travel times because the LOTTR values are below 1.25.



## LEVEL OF TRAVEL TIME RELIABILITY



**FIGURE 5.** Example Level of Travel Time Reliability Map



## NORTH REGION: OVERVIEW

### NORTH REGION: DELAY INDEX

The following table ranks the North Region freeways based on the delay index. Each freeway segment is presented on a countywide or TSC basis, as appropriate.

**TABLE 2. 2018 North Region Delay Index Data**

Rank	Location (Route, County)	2018 Delay Index per Mile (in minutes)
1	I-75 – Gaylord TSC	386
2	US-131 – Wexford County	381
3	US-127 – Gaylord TSC	330



## NORTH REGION: CONGESTION SEVERITY

The following tables display the amount of congestion miles per region that fall into each severity level. Table 3 shows this data during the AM peak and Table 4 shows this data during the PM peak. These tables can be utilized to compare the amount and severity of congestion across all regions. Figures 6-7 represent this information specifically in the North Region. Figure 6 shows the congestion severity during the AM peak and Figure 7 shows the congestion severity during the PM peak.

**TABLE 3. 2018 Congestion Miles by Severity - AM Peak**

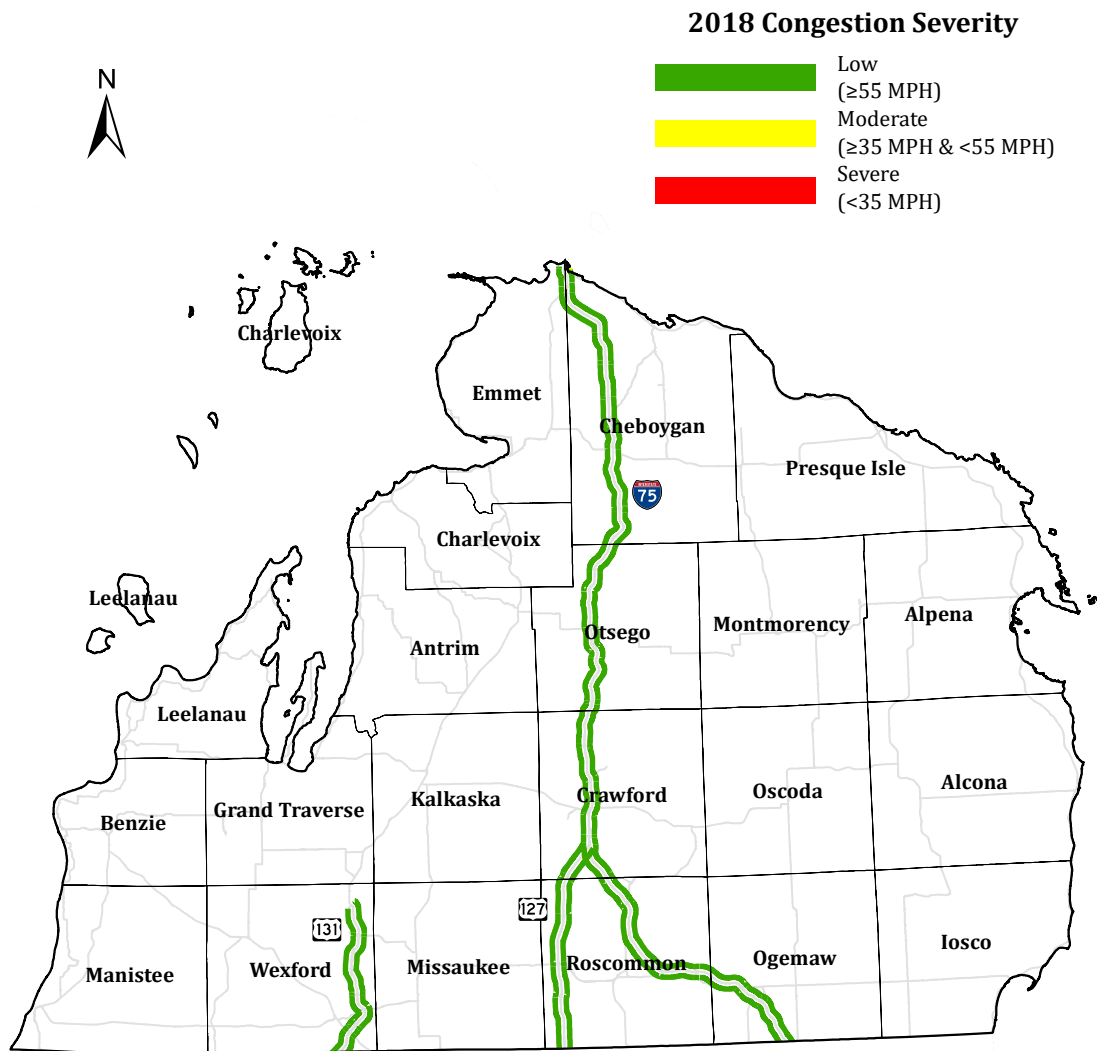
Region	Low	Moderate	Severe
Bay	772.9	0.0	0.0
Grand	668.9	36.8	0.0
Metro	405.1	139.9	32.4
North	358.2	0.3	0.0
Southwest	471.0	0.0	0.0
Superior	95.2	0.0	0.0
University	715.8	37.0	3.6
Total	3487.1	214.1	36.1

**TABLE 4. 2018 Congestion Miles by Severity - PM Peak**

Region	Low	Moderate	Severe
Bay	770.3	2.5	0.0
Grand	658.6	37.6	9.4
Metro	348.7	151.7	77.1
North	358.2	0.3	0.0
Southwest	471.0	0.0	0.0
Superior	95.2	0.0	0.0
University	719.9	24.7	11.8
Total	3422.0	216.9	98.3



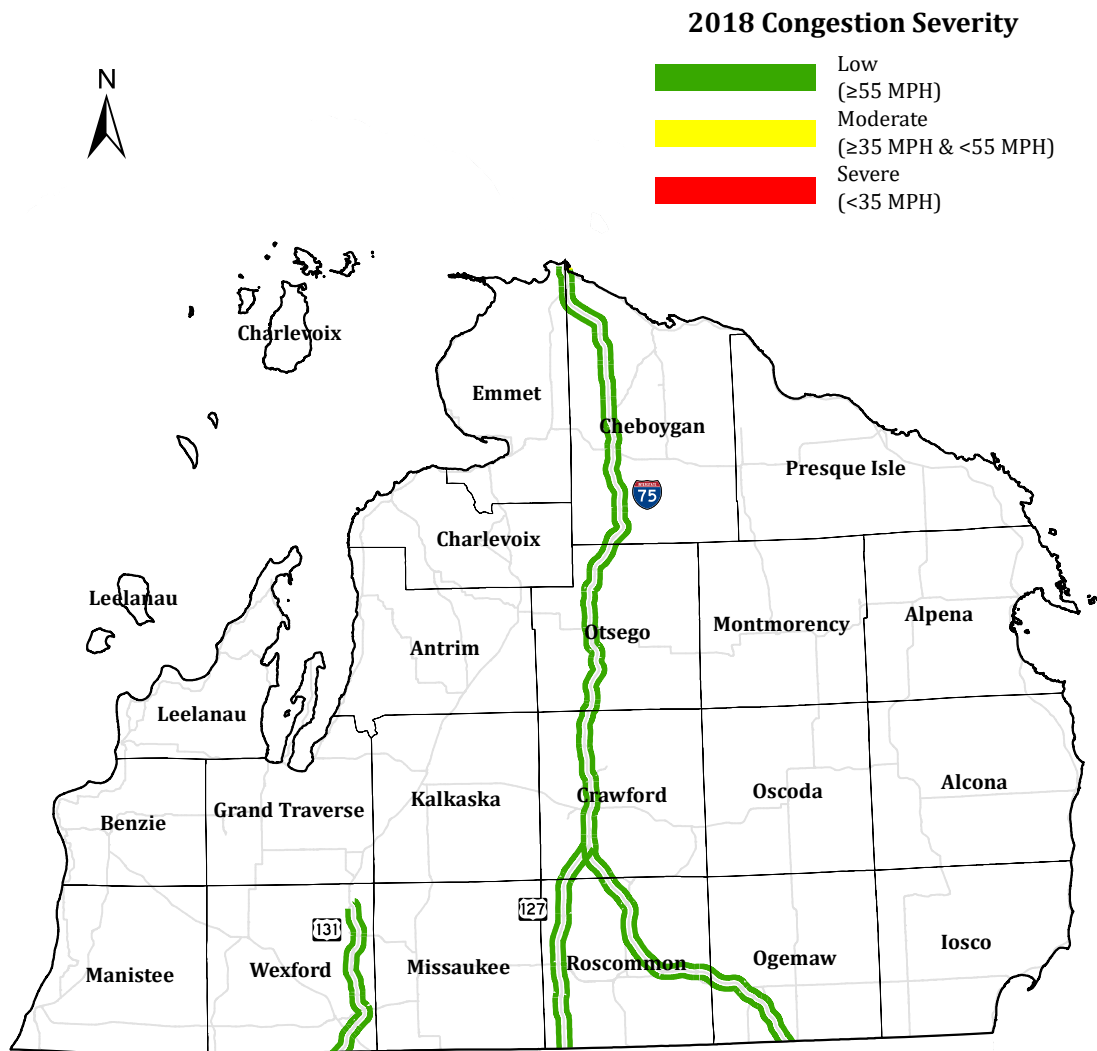
## NORTH REGION: CONGESTION SEVERITY



**FIGURE 6. 2018 North Region AM Peak Congestion Severity**



## NORTH REGION: CONGESTION SEVERITY

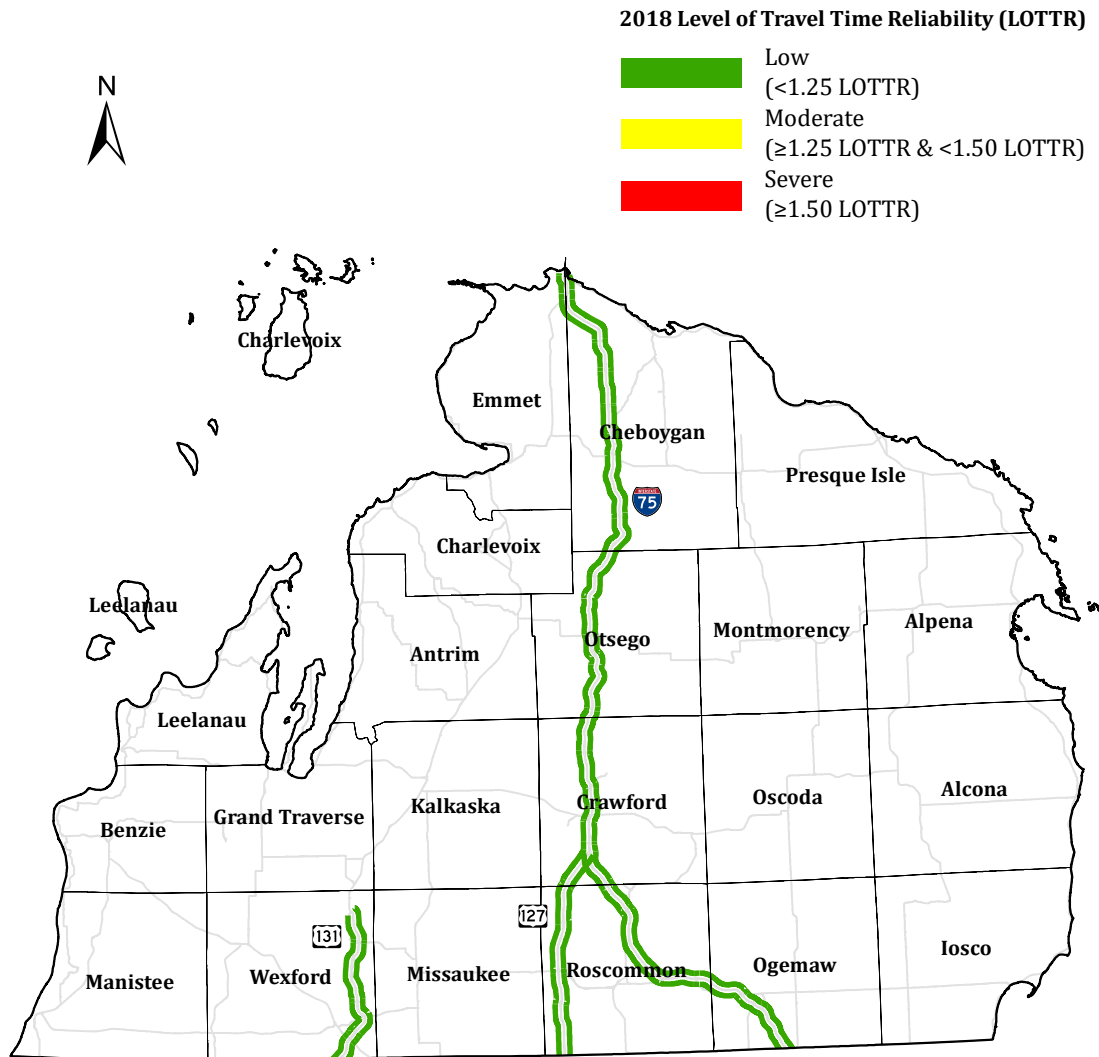


**FIGURE 7. 2018 North Region PM Peak Congestion Severity**



## NORTH REGION: LEVEL OF TRAVEL TIME RELIABILITY

The following figures display the level of travel time reliability (LOTTR) based on severity level in the North Region. Figures 8-10 display the LOTTR during weekdays between 6:00 – 10:00 AM, 10:00 AM – 4:00 PM, and 4:00 PM – 8:00 PM, respectively. Figure 11 displays the LOTTR during weekends between 6:00 AM – 8:00 PM.

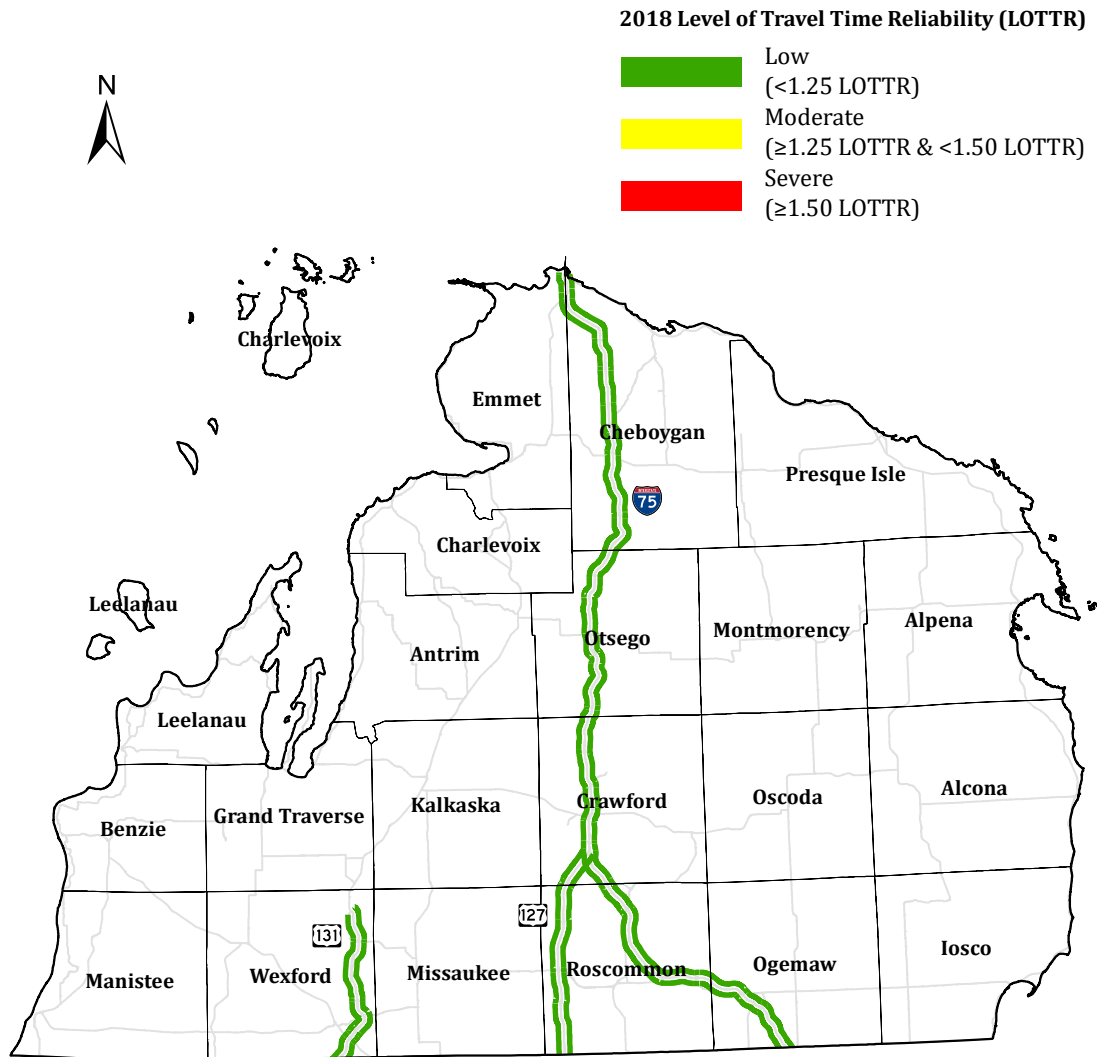


**FIGURE 8. 2018 North Region Level of Travel Time Reliability**  
(Weekdays between 6:00 AM – 10:00 AM)





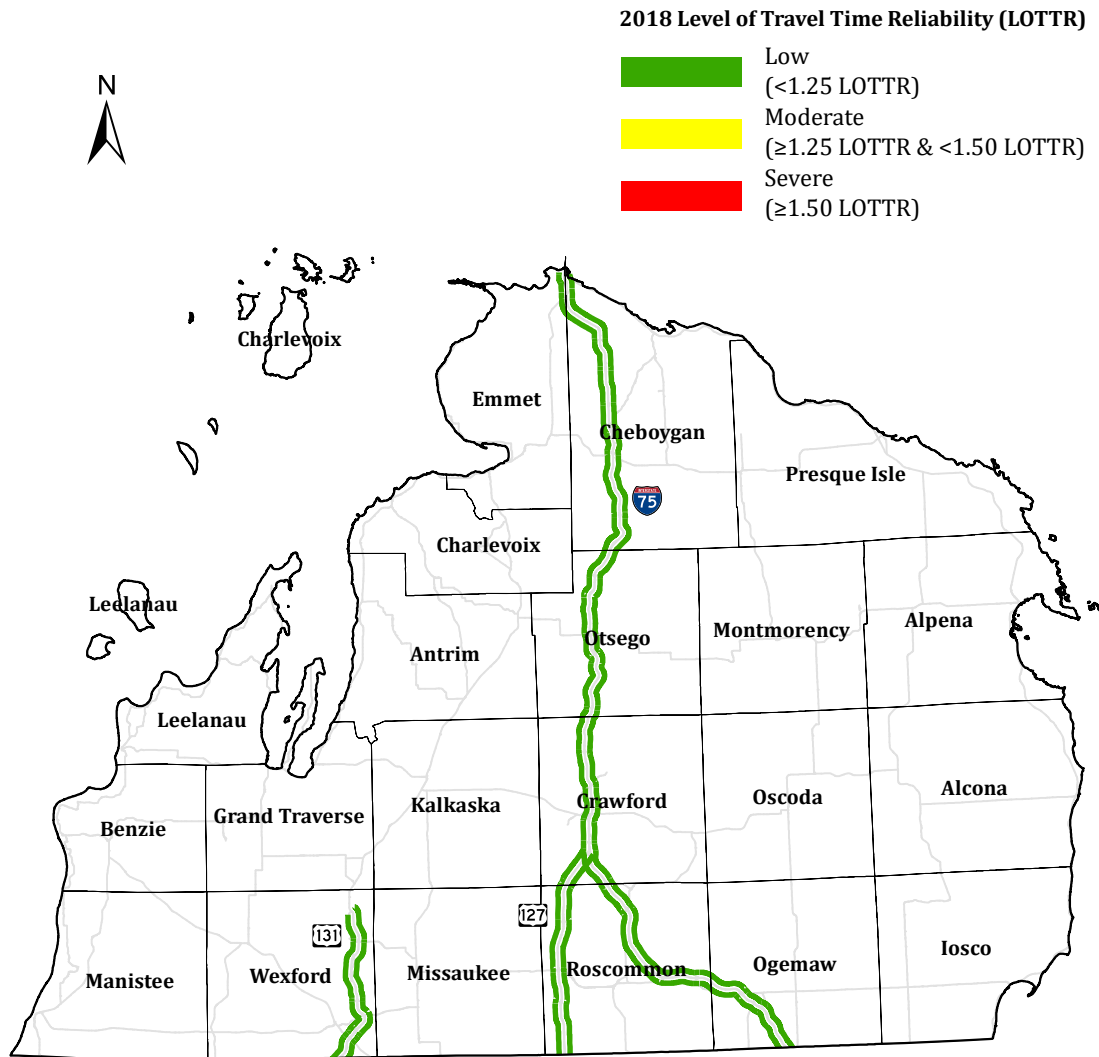
## NORTH REGION: LEVEL OF TRAVEL TIME RELIABILITY



**FIGURE 9. 2018 North Region Level of Travel Time Reliability**  
(Weekdays between 10:00 AM – 4:00 PM)



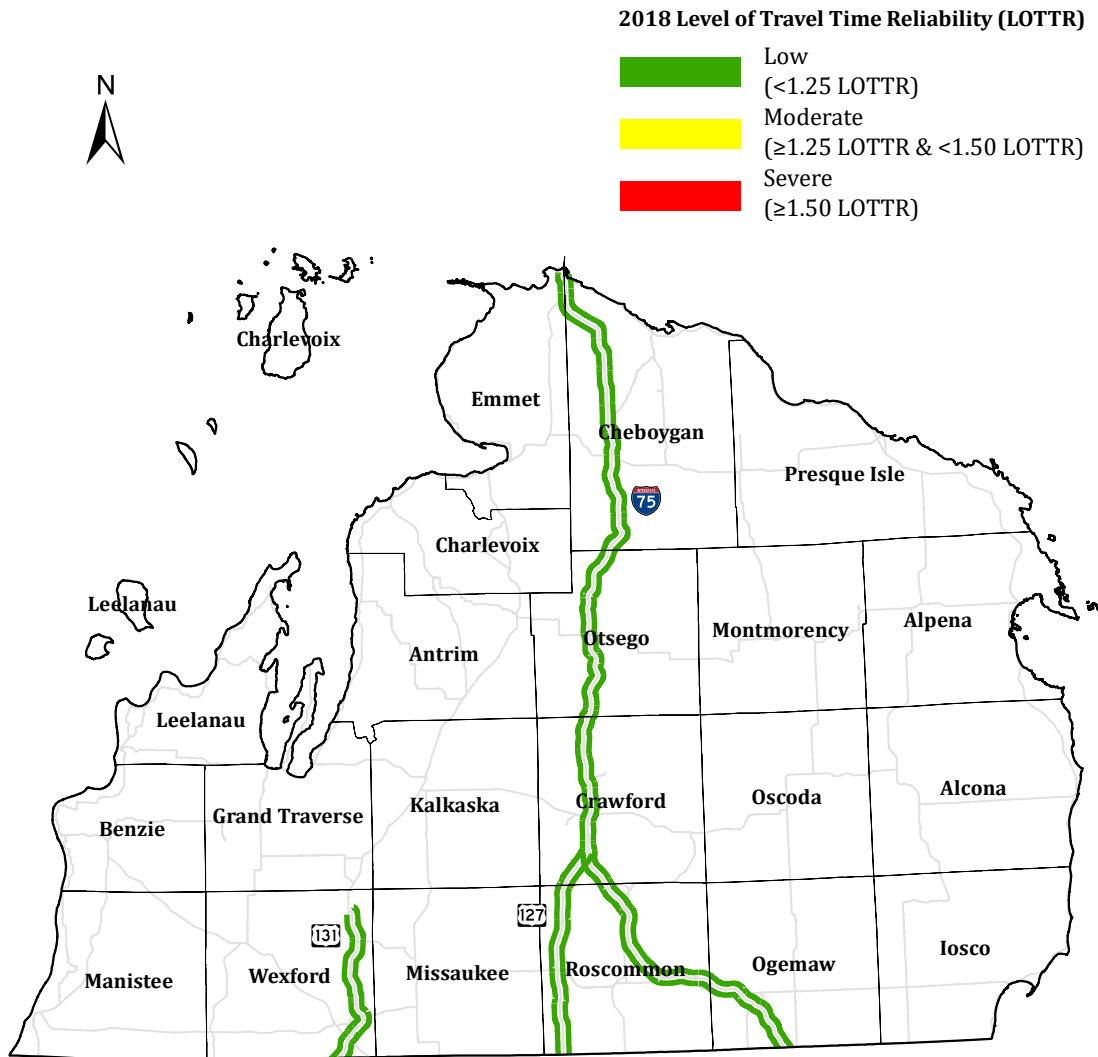
## NORTH REGION: LEVEL OF TRAVEL TIME RELIABILITY



**FIGURE 10. 2018 North Region Level of Travel Time Reliability**  
(Weekdays between 4:00 PM – 8:00 PM)



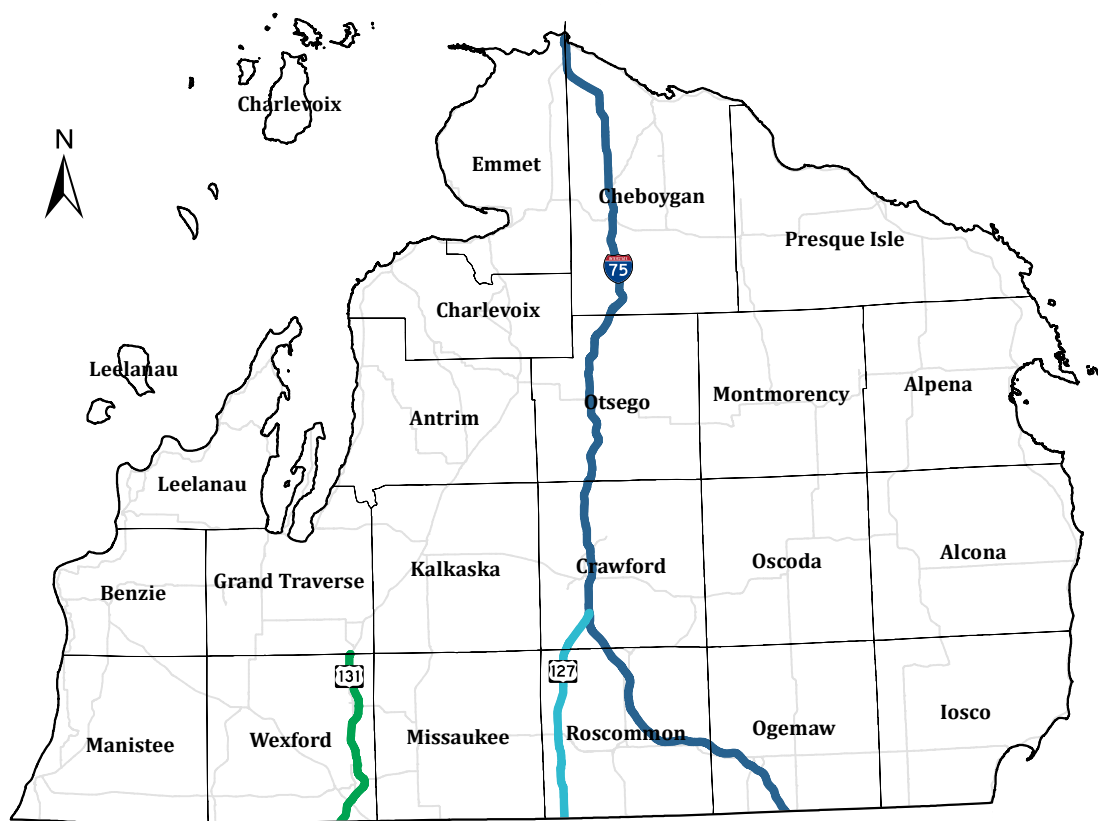
## NORTH REGION: LEVEL OF TRAVEL TIME RELIABILITY









**FIGURE 11. 2018 North Region Level of Travel Time Reliability**  
(Weekends between 6:00 AM – 8:00 PM)



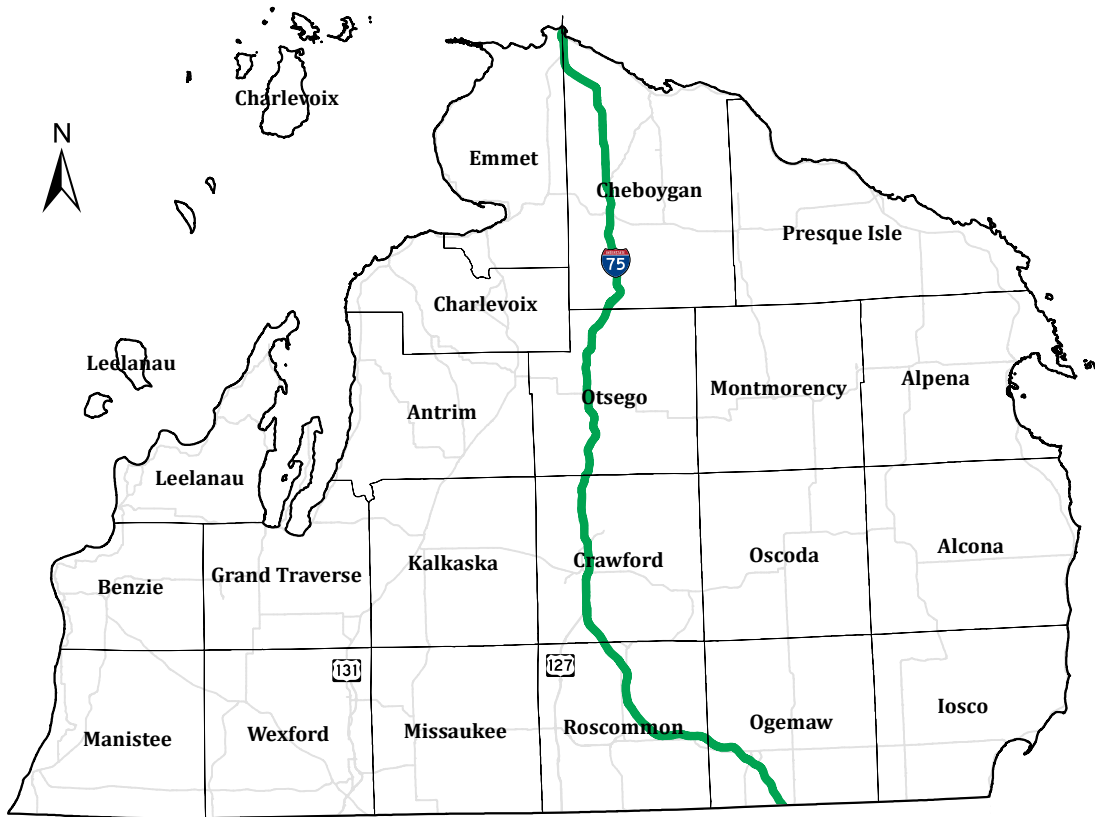
## NORTH REGION: CORRIDOR GLOSSARY



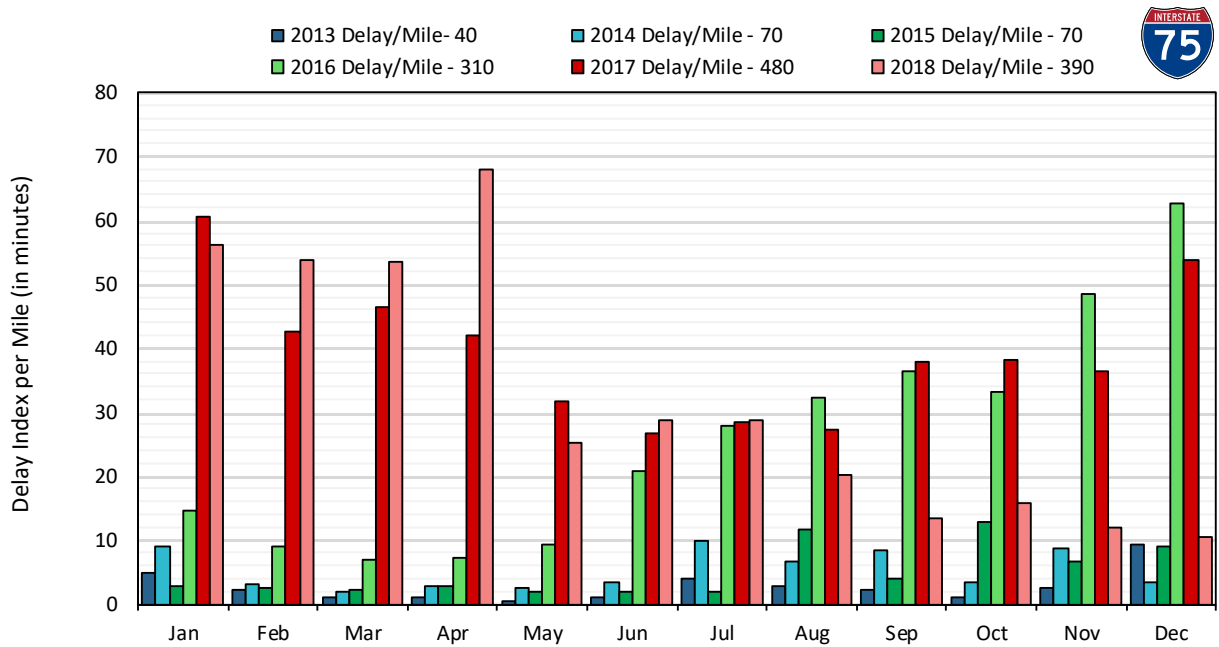
		I-75: Gaylord TSC	Pg. 21
		US-127: Gaylord TSC	Pg. 22
		US-131: Wexford	Pg. 23



## I-75: GAYLORD TSC DELAY INDEX



a) Segment Map

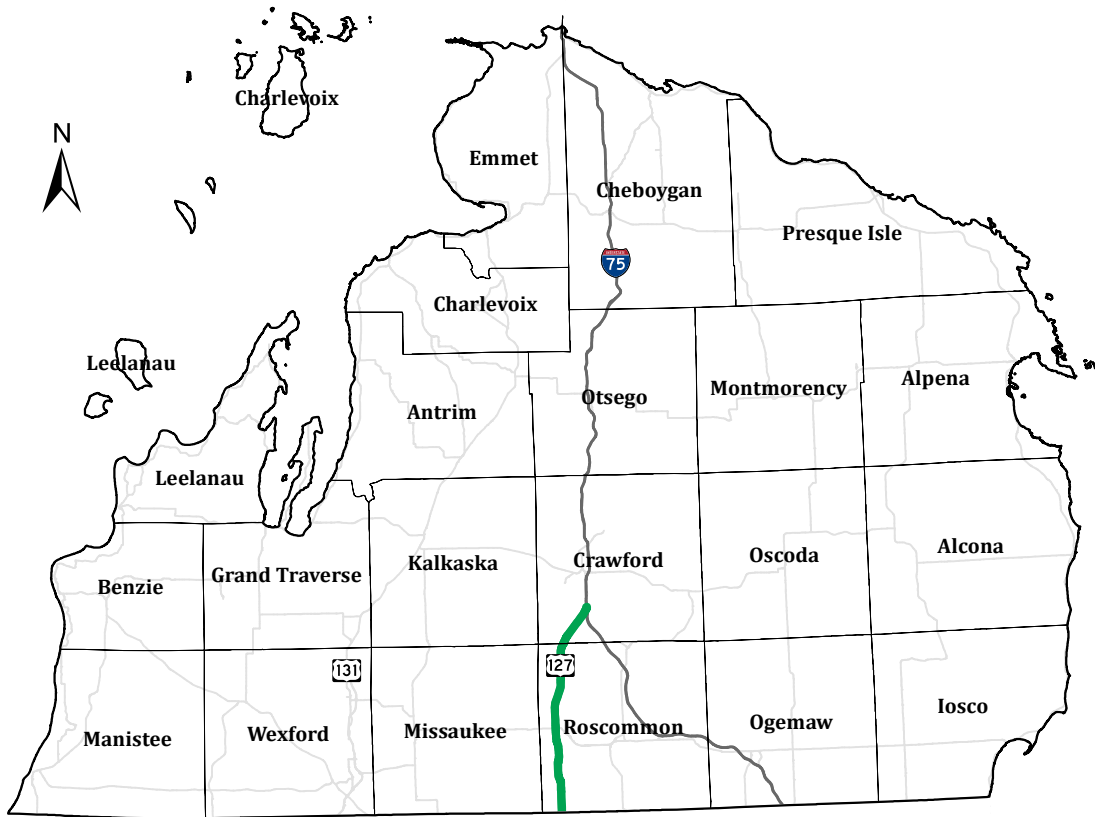


b) Delay Index Graph

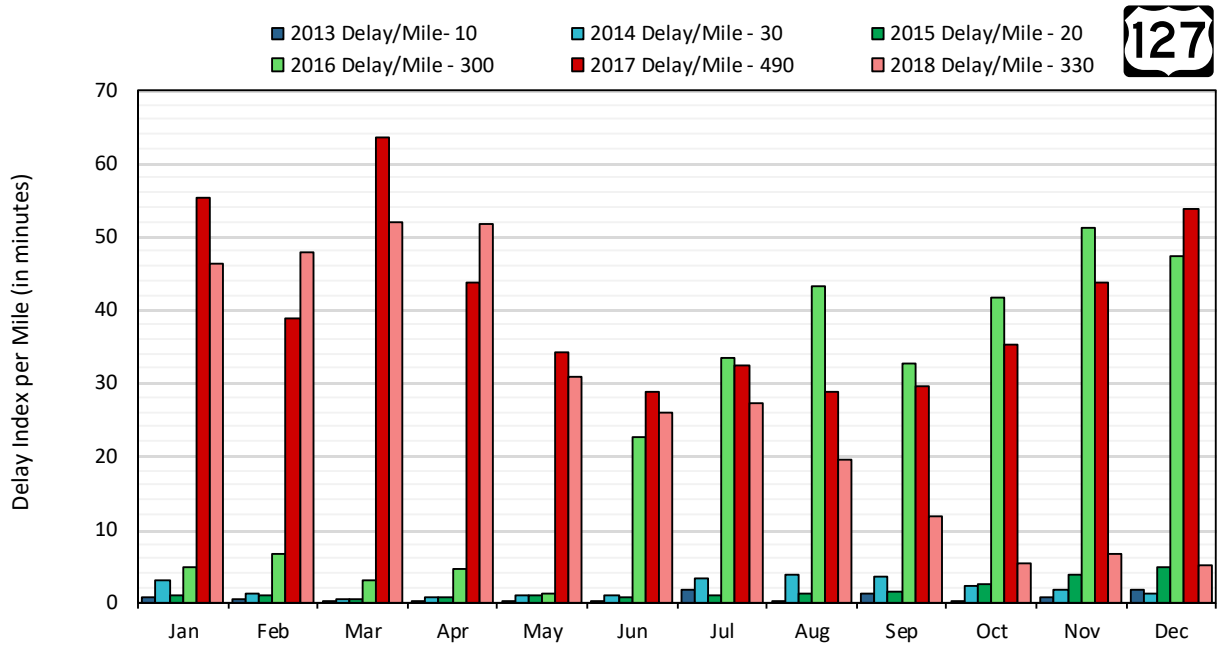
FIGURE 12. Gaylord TSC I-75 Corridor Delay Index



## US-127: GAYLORD TSC DELAY INDEX



a) Segment Map



b) Delay Index Graph

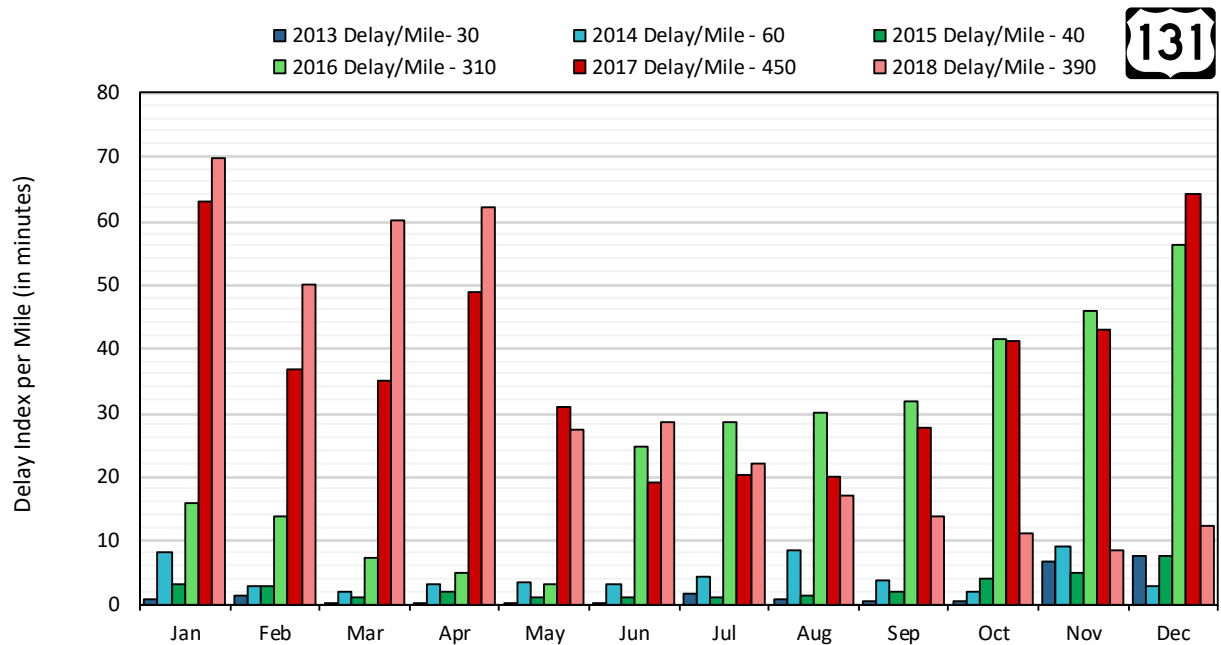
FIGURE 13. Gaylord TSC US-127 Corridor Delay Index



## US-131: WEXFORD COUNTY DELAY INDEX



a) Segment Map



b) Delay Index Graph

FIGURE 14. Wexford County US-131 Corridor Delay Index



## CONCLUSION

This chapter summarizes the performance of the North Region. It is the Congestion and Reliability Unit's goal that these performance measures are not just numbers and figures, but information to help MDOT personnel understand how traffic is operating on its freeways and make actionable decisions on improving traffic. These metrics could be used to help prioritize projects, determine where and when problems are occurring, and how significant these problems are. We intend to provide these performance measures on an annual basis to help identify trends on the system and to keep MDOT up to date on freeway operations. Various performance measures may change due to changing federal requirements or MDOT needs. As probe data improves, this may expand to non-freeway routes as well. The Congestion and Reliability Unit welcomes any feedback on this report to help us improve it in the future and maximize its usefulness.

## CONTACT INFORMATION

Please contact the Congestion and Reliability Unit if you have any questions/comments or would like to have the actual data for further analysis.

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